(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 December 2001 (20.12.2001)

PCT

(10) International Publication Number
WO 01/97553 A2

(51) International Patent Classification[7]: H04Q 7/38

(21) International Application Number: PCT/SE01/01376

(22) International Filing Date: 15 June 2001 (15.06.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/593,696 15 June 2000 (15.06.2000) US

(71) Applicant: TELEFONAKTIEBOLAGET L M ERICSSON (publ) [SE/SE]; S-126 25 Stockholm (SE).

(72) Inventors: SAMMOUR, Mohammed; Apt.#1011, 1100 Dr. Penfield, Montreal, Quebec H3A 1A8 (CA). GREYLING, Carl; Avenida Virreyes no. 1590, Lomas de Chapultepec, Mexico, D.F. 11000 (MX).

(74) Agent: MAGNUSSON, Monica; Ericsson Radio Systems AB, Patent Unit Radio Access, S-164 80 Stockholm (SE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *without international search report and to be republished upon receipt of that report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

WO 01/97553 A2

(54) Title: METHOD AND APPARATUS FOR OBTAINING MEASUREMENT DATA FOR PERFORMANCE ANALYSIS IN A RADIO NETWORK

(57) Abstract: A method and apparatus for obtaining relevant measurement data for analysis of radio network (10) performance. Measurement data (M1-M4) from different network entities (E1-E4) is collected and saved regularly (100). As each saved batch of data is shorter than the total time, temporal accuracy is improved as the time window for when an event could have occurred is shortened. Data processing starts by finding (102) all entities (E2-E4) (usually cells (C1-C4) that potentially interface with the entity (E1) being analysed. The entities (E1-E4) are then classified (104) according to link usage. The measurement data (M1-M4) is filtered (106) to obtain only those records that correspond to a certain network (10)traffic scenario. The output data (108) is suitable for statistical calculations are performed (108) to obtain the results of the analysis.

# METHOD AND APPARATUS FOR OBTAINING MEASUREMENT DATA FOR PERFORMANCE ANALYSIS IN A RADIO NETWORK

## BACKGROUND OF THE INVENTION

### Technical Field of the Invention

The present invention relates to radio networks and, more specifically to an apparatus and a method for obtaining measurement data for performance analysis in such networks.

### Description of the Related Art

Operators of radio networks, and specifically mobile radio networks (hereinafter used as an example), have an interest in providing the best possible service with the available equipment. One way of improving service is to ensure good transmission properties by minimising interference and hardware problems, maximising coverage and so on.

In order to be able to improve the network, relevant measurement data must be collected before any analysis can be performed.

A common method is to rely on the experience and intuition of the technicians performing the analysis to come up with possible improvements. The solutions are then tested in order to provide feedback. Obviously, this way of working, while sometimes quite successful, suffers from drawbacks. Very experienced personnel are needed, which increases costs if such staff are available at all. The reliance upon 'feelings' is not quantifiable, leading to poor information for decision making, for instance about whether or not new equipment should be bought. Furthermore, the trial-and-error approach may be time and resource consuming leading to an increase in costs for the network operator and, ultimately, the customers.

More scientific methods try to identify interference sources based on correlation between events, such as for example correlating the utilisation of a first channel in a first cell in the network with the interference in a second channel in a second, potentially interfering cell. If the correlation between utilisation and interference is strong, that is a good indication that the source of the interference is the

first channel. A drawback with this method is that, as this method only takes into account measurement data from two cells at a time, it may lead to false identification of interference sources. In addition, not all systems are able to provide time stamped data.

Yet another method tries to correlate interference with voice channel seizure events. Drawbacks with this method are that, as it uses event-event correlation, it takes a relatively long time to perform the calculations, and that there is an increase in processor load in the switch collecting the measurements. In addition, not all systems are able to provide time stamped data.

As with most statistical methods, the reliability and usefulness increase with an increase in the amount and the quality of the data. A person with ordinary skill in the art will appreciate that this poses a problem for methods not using time stamps, as the accuracy in time diminishes if data is collected over a long time period. For example, if data is collected over a 24 hour period, there is a distinct possibility that valuable data has been recorded, but that, without time stamps, it is impossible to know when, during these 24 hours, the interesting phenomena occurred.

Based on the foregoing, it can be readily appreciated that there is a need for a simple, efficient solution to the problems of how to obtain relevant measurement data for the analysis of radio network performance problems. The present invention provides a solution to this problem.

## SUMMARY OF THE INVENTION

In one aspect, the present invention is directed to a method and an apparatus for increasing the temporal accuracy of measurement data.

In another aspect, the present invention is directed to several embodiments of a method and an apparatus for obtaining relevant measurement data for the analysis of radio network performance.

### Brief Description of the Drawings

For a more detailed understanding of the invention, for further objects and advantages thereof, reference can now be made to the following description, taken in conjunction with the accompanying drawings, in which:

Figure 1 shows a block diagram illustrating a traffic scenario in a mobile radio network;

Figure 2 shows a block diagram illustrating another traffic scenario in a mobile radio network;

Figure 3 shows a kind of flow chart illustrating processing of data according to the method;

Figure 4 illustrates how the obtained relevant measurement data can be used to analyse network performance problems; and

Figure 5 shows a block diagram illustrating an apparatus for analysing network performance problems.

Detailed Description of the Preferred Embodiments

In order to facilitate understanding of analysis of radio network performance problems two network traffic scenarios will initially be given.

FIG. 1 illustrates a mobile radio network traffic scenario. Four cells C1-C4 that potentially interfere with each other are shown in mobile radio network 10. Each cell, C1-C4, comprises a base station 12, 22, 32 and 42 respectively. A number of mobile stations are located in the cells C1-C4, represented by one mobile station 11, 21, 31 and 41 in each cell C1-C4. In the traffic scenario shown in the figure, cells C3 and C4 are idle. In this and the following example this means that there is no communication going on between the base station 32 and 42, and the mobile stations 31 and 41 respectively – in reality this would be applicable to each of the different channels in a cell. In cell C2 the mobile station 21 communicates with the base station 22; that is the cell is busy. Regardless of whether or not cell C1 is idle or busy, with the right equipment it is possible to measure the influence of the traffic in cell C2 on cell C1. This will be discussed further on.

FIG. 2 illustrates another mobile radio network traffic scenario, similar to the scenario illustrated in FIG. 1. The cells, C1-C4, the base stations 12, 22, 32 and 42, and the mobile stations 11, 21, 31 and 41 are the same as in FIG. 1. In this scenario, however, none of the cells C2-C4 is busy, which means that for instance coverage problems, problems with the equipment in cell C1 and external interference, i.e. interference originating from outside the mobile radio network 10, can be measured

and analysed.

Now that it is clear what kind of analyses can be made and in what kind of network traffic scenarios it works, it is time to describe the collection of the data that makes said analyses possible.

There are many interesting parameters that can be measured in a mobile radio network for subsequent performance analysis. These parameters are for example signal strength when the channel is busy (Busy SS) and when it is idle (Idle SS), and the Bit Error Rate (BER) on the uplink as well as the downlink. Some of these parameters, the uplink parameters, are measured by the base station equipment, while others, the downlink parameters are measured by the mobile station.

As discussed earlier, measurement data without time stamps do not provide important temporal information, for instance, for analysing network performance. A solution to this problem is to take measurements and to save regularly the measurement data amassed in a relatively short time interval. An example will clarify: supposing that measurement data is to be collected for two hours, the standard way of doing this would be to collect data during those two hours and to store them all in one file. To increase temporal accuracy, however, measurement data will still be collected during the same two hours, but measurement data collected during a pre-set shorter time interval, say 10 minutes, will be stored separately. This will create 12 files for the two-hour period and it will be possible to know, to within 10 minutes at most, when the recorded events in each file occurred. Hence the temporal accuracy of the measurement data will be improved. In addition, it will be easier to detect various occurrences in the network, as data tend to smear together if collected over an extended period of time.

Collecting data as described above can be done in two ways. If possible, the measurement program itself can run once and produce the twelve files. On the other hand, if the measurement program can only produce one file at the end of the measurement, then the measurement program will have to be run twelve times. Both ways produce essentially the same results, with a possible difference that the second way may miss some data when stopping and restarting the measurement program.

It should be understood that the optimal division of a time interval into shorter time intervals depends on the circumstances, for example the rate with which

measurement data is recorded, the length of the measurement period, the expected changes in the scenarios and the duration of an "interesting" event. What is important for the later analysis is that the measurement data has good temporal accuracy and that corresponding measurements are collected at the same time.

With the measurement data at hand, it is now necessary to obtain relevant data for subsequent analysis of network performance. FIG. 3 is a block diagram illustrating processing of data according to the method. A number of exchanges (MSCs) E1, E2, E3, E4, that, among other things, collect measurement data are shown symbolically next to the measurement data M1, M2, M3, M4, collected by the exchanges. The measurement data is collected from various entities comprised in that exchange, where an entity for example could be a cell, a channel, a device or a frequency band. In this case there are four exchanges and four corresponding sets of data; in reality there could very well be one set of measurement data for each exchange in the network. The measurement data M1, M2, M3 and M4 respectively are collected, either directly in real time or retrieved from some computer readable medium, in step 100, and the measurement data for the entity to be analysed is obtained. The measurement data are made up of several different periods of measurement, ranging from 1 to N. The measurement data from a first period of measurement at exchange E1 is denoted M11, the data form the second period M12 and so on. The different periods making up the measurement data M1, M2, M3, M4, are often continuous as well as disjunct in time but this is no absolute requirement. Nor is there any requirement as to the number of periods – with some luck, interesting results could arise from a single period - but as the method is statistical, it usually improves with the amount of data, at least up to a certain degree. The measurement data M1, M2, M3, M4, from the different exchanges E1, E2, E3, E4, should be collected at the same time, however.

With the measurement data M1, M2, M3, M4, at hand, it is time to filter it, step 102, to obtain data for all the entities that are "potentially interfering" with the analysed entity. This could be done for a single entity or for several entities at the same time. In this case potentially interfering means that they reasonably can be expected to affect the analysed entity. In a mobile radio network, this will usually be entities with or using the same frequency or channel as the analysed entity (co-channel entities) as well as entities with or using a neighbouring frequency or channel

(adjacent-channel entities). Assume, in this case, that all of the entities corresponding to the exchanges E1-E4 potentially interfere with each other. Normally, the filtering would be on measurement data originating from cells, both co-channel and adjacent channel, understood that the measurements could be made on an entity within that cell. At this stage, it is also advantageous to classify the entities (or cells) as co-channel or adjacent-channel with regard to each analysed entity. In addition, the number of potentially interfering entities can be recorded.

The next step, 104, is to classify the entities (again usually the cells) according to usage. The utilisation of both the uplink and the downlink channels are calculated, advantageously as a percentage. At this stage, or later, each channel could be classified as "Idle", i.e. the utilisation is below a certain threshold value, or "Busy", i.e. utilisation above another certain threshold value. It should be understood that "Idle" and "Busy" are not absolutes; for instance, a utilisation of 10% is not, strictly speaking, the same as totally idle, but for the purposes of the analysis it could very well be close enough to idle to have a minimal, or at least acceptable, influence on the analysis. In addition, it is possible to have further classifications, for example "Almost idle", "Rather busy" and so on.

After having classified the cells according to usage it is necessary to filter the measurement data further, possibly by first selecting a sub-set of the measurement data and then by selecting only those instances that fit a certain traffic scenario; step 106.

From a user point of view, i.e. someone working with radio network performance optimisation or improvement using a software tool comprising the present invention, it might be advantageous to select a sub-set of the measurement data. This is due to the fact that the user is not always interested in considering all the measurement data, but might be content with, for instance, only the data from a specific exchange. There are many different options to filter with regard to, for example:

A specific system or group of systems

A specific exchange or group of exchanges

A specific cell or group of cells

A specific frequency or group of frequencies

Specific times or time periods

One or more specific potentially interfering cells

Utilisation of specific links

Above-mentioned filtering could of course be performed almost anytime as long as it occurs before the subsequent statistical calculations.

Whether or not a sub-set of the data was selected above, filtering with regard to specific traffic patterns is now necessary. This filtering is necessary in order to obtain measurement data with the proper characteristics for later analysis, for instance by filtering according to the utilisation of the radio links associated with the relevant entities. An example, referring again to FIG. 1, is to sort out all the measurement periods for which an entity in cell C1 is either Idle or Busy, while at the same time the entity in cell C2 is Busy, and the entities in cells C3 and C4 are Idle. Another possibility is to sort on the instances where all co-channel cells are idle. See the descriptions of FIG. 1 and FIG. 2 above for further explanations.

If more than one instance fit the filtering profiles so far, two general options are available. The first option is to add all of said measurement data into a conglomerate, while the second option is to treat each batch of suitable measurement data individually, with the possibility to combine the results into one, single result later.

The properly filtered measurement data is the output, 108, needed to perform the statistical calculations. Many different calculations are then possible; the following list gives some examples:

Finding the amount of uplink or downlink interference caused by one of the interfering cells.

Finding potential external uplink or downlink interference or hardware/device problems.

Finding the amount of uplink or downlink BER caused by one of the interfering cells.

Finding potential uplink or downlink coverage problems.

An example of statistical calculations will now follow. A common way of measuring interference is to measure Idle Signal Strength, i.e. the signal strength that can be measured although there is no communication in a particular cell for a specific channel. As there is no communication in the cell itself, all of the signal strength must

come from other sources, e.g. co-channel cells. With the suitable measurement data – filtered as described above – it is possible to calculate a percentile, say the 90% percentile. This will show what value the Idle Signal Strength was lower than (or equal to) 90% of the time. This value can be used for many things, one use is to save the values to see if the interference increases or decreases over time.

Another example of what the value can be used for will further explain the utility measurement data processed according to the method; see Figure 4. In this figure, seven cells are shown: a central cell C41, surrounded by six co-channel cells, C42-C47. In order to see if any of the co-channel cells C42-C47 interfere with the central cell C41, the method as described above can be used iteratively. First, measurement data for the central cell C41 and for all other cells is collected, 100. The utilisation of all the links is computed, 104, and the measurement data is filtered twice, 106; first, if measurement data has been collected for more than the seven mentioned cells C41-C47, to obtain only the measurement data for the co-channel cells C42-C47. A second, iterative filtering will obtain all the measurement data for which the central cell C41 was Idle and for which, in turn, one of the co-channel cells C42-C47 was Busy, while the rest were Idle. The statistical calculation to obtain the percentile is performed for each of those six cases. Statistically, the highest value will be associated with the cell that interferes the most with the central cell C41.

In the description above, only one entity is analysed, but it should be understood that the analysis could be performed for all the entities at the same time if desired.

Figure 5 shows a block diagram illustrating an apparatus for processing measurement data to obtain relevant measurement data for analysis of network performance problems. The apparatus 50 comprises means for collecting measurement data 52, either directly or by reading files containing measurement data. Three filters 54-56 are used for obtaining measurement data for the entity that is to be analysed (filter 54), obtaining measurement data for potentially interfering entities (filter 55) and filtering measurement data with respect to a sub-set of the measurement data and specific network traffic patterns (filter 56). A processor 58 computes the utilisation of radio links. Another (or possibly the same) processor 59, although not part of the invention as such, that calculates statistically at least one result to the specific radio

network performance question posed, can also be incorporated.

Although several preferred embodiments of the method and system of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

What is claimed is:

1.A method for obtaining relevant measurement data for the analysis of radio network (10) performance comprising the steps of:

- collecting (100) measurement data;
- obtaining the measurement data for a first entity, that is to be analysed;
- obtaining (102) the measurement data for a number of entities that potentially interfere with said first entity;
- computing (104) the utilisation of all radio links associated with the entities obtained above; and
- filtering (106) all of the measurement data with respect to specific traffic patterns.

2.The method according to claim 1, where at least part of the measurement data (M1-M4) is retrieved from files recorded on one or several computer readable mediums.

3.The method according to claim 1, where at least part of the measurement data (M1-M4) is collected in real-time.

4.The method according to claim 1, where the potentially interfering entities comprise any entity that at least partly uses the same frequency band as the entity that is analysed.

5.The method according to claim 4, where the potentially interfering entities comprise any entity that uses the same channel as the entity that is analysed.

6.The method according to claim 1, where the potentially interfering entities comprise any entity that uses an adjacent radio channel relative to the analysed entity.

7.The method according to claim 1, where an entity could be a cell (C1-C4) in a mobile radio network (10).

8.The method according to claim 1, where an entity could be a frequency band in a mobile radio network (10).

9.The method according to claim 1, where an entity could be a channel in a mobile radio network (10).

10.The method according to claim 1, where an entity could be a device in a mobile radio network (10).

11.The method according to claim 1, where the number of entities that potentially interfere with said first entity includes all potentially interfering entities for which measurement data (M2-M4) has been recorded.

12.The method according to claim 1, where a traffic pattern is determined according to the utilisation of the radio links associated with the relevant entities.

13.An apparatus (50) for obtaining relevant measurement data for the analysis of radio network performance comprising:

1. a device (52) for collecting measurement data for a specific time period;
2. a first filter (54) for obtaining the measurement data for a first entity, that is to be analysed;
3. a second filter (55) for obtaining the measurement data for a number of entities that potentially interfere with said first entity;
4. a processor (58) for computing the utilisation of all radio links associated with the entities obtained above; and
5. a third filter (56) for filtering all of above-mentioned measurement data with respect to specific traffic patterns.

14.A method of increasing the temporal accuracy of measurement data lacking time stamps by dividing the time during which the measurements are to be recorded into at least two time intervals during which the measurements are made.

15.The method according to claim 14 further characterised in that the above-mentioned time intervals are disjunct in time.

16.The method according to claim 14 further characterised in that the above-mentioned time intervals together cover the entire time during which the measurements are made.

17.The method according to claim 14 further characterised in that the measurements during a certain time period are recorded in a file on a computer readable medium.

18.The method according to claim 17 further characterised in that the above-mentioned file in addition is provided with at least one time stamp.

19.The method according to claim 18 further characterised in that the above-mentioned time stamp is the time when the file was saved provided by the computer.

20.The method according to claim 18 further characterised in that the time stamp records the time when the measurements started.

21.The method according to claim 18 further characterised in that the time stamp records the time when the measurements ended.

22.The method according to claim 18 further characterised in that there are two time stamps that record the times when the measurements started and ended, respectively.

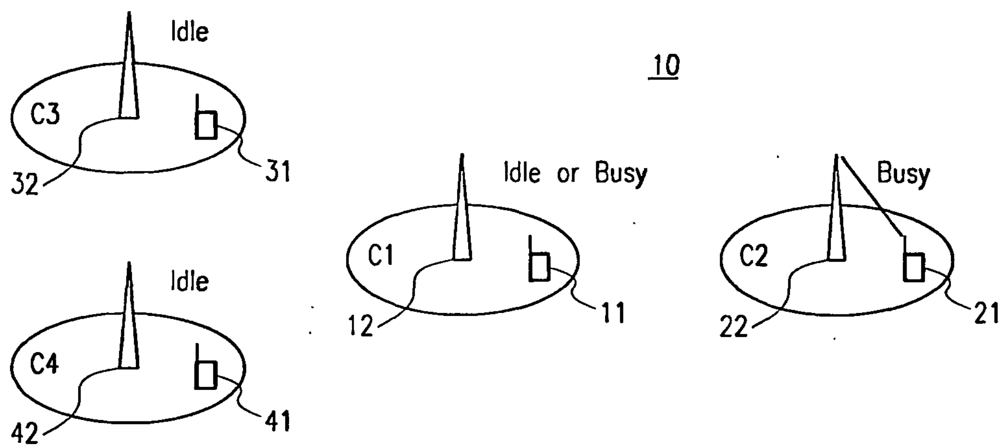

Idle
10
C3
32
31
Idle or Busy
Busy
C1
12
11
C2
22
21
Idle
C4
42
41

*FIG. 1*

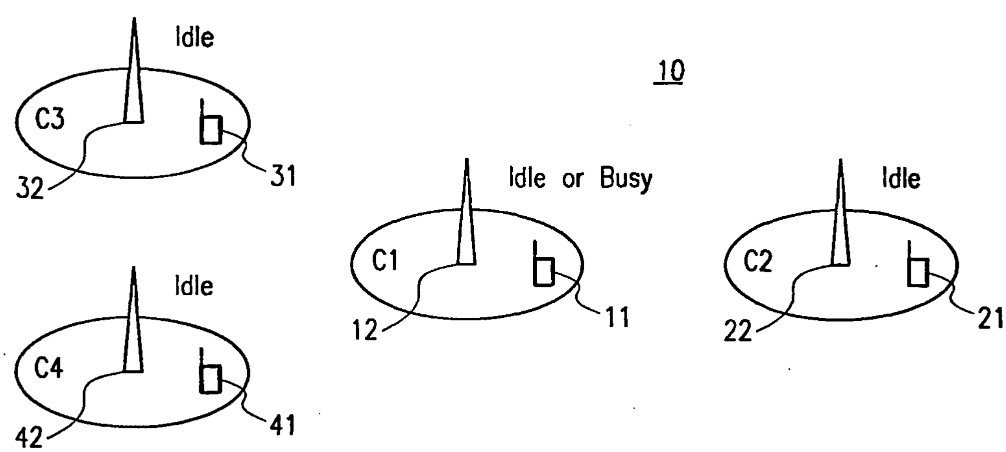

Idle
10
C3
32
31
Idle or Busy
Idle
C1
12
11
C2
22
21
Idle
C4
42
41

*FIG. 2*

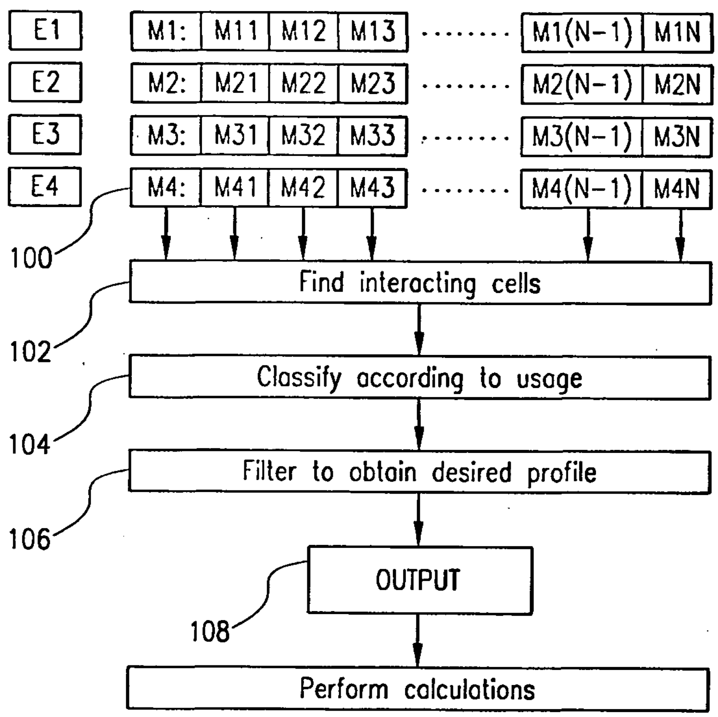

E1
E2
E3
E4
M1: M11 M12 M13 ........ M1(N-1) M1N
M2: M21 M22 M23 ........ M2(N-1) M2N
M3: M31 M32 M33 ........ M3(N-1) M3N
M4: M41 M42 M43 ........ M4(N-1) M4N
100
Find interacting cells
102
Classify according to usage
104
Filter to obtain desired profile
106
OUTPUT
108
Perform calculations

*FIG. 3*

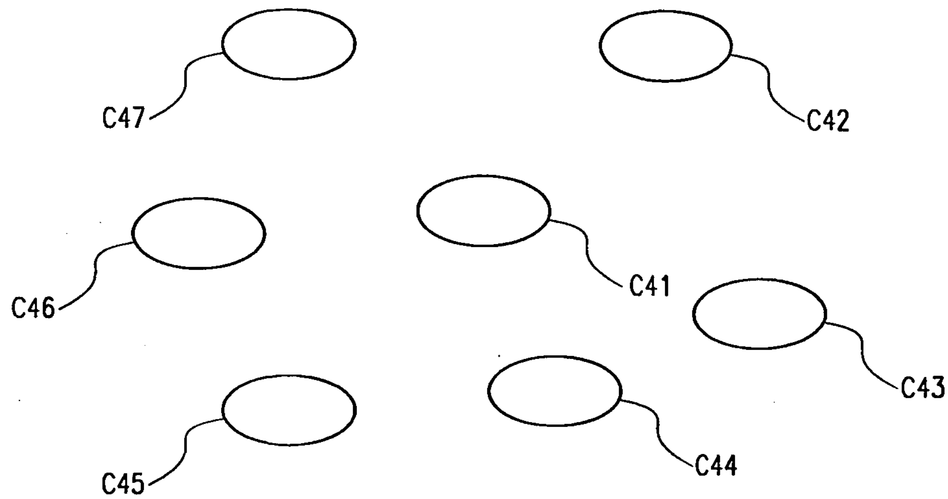

C47
C42
C46
C41
C43
C45
C44

FIG. 4

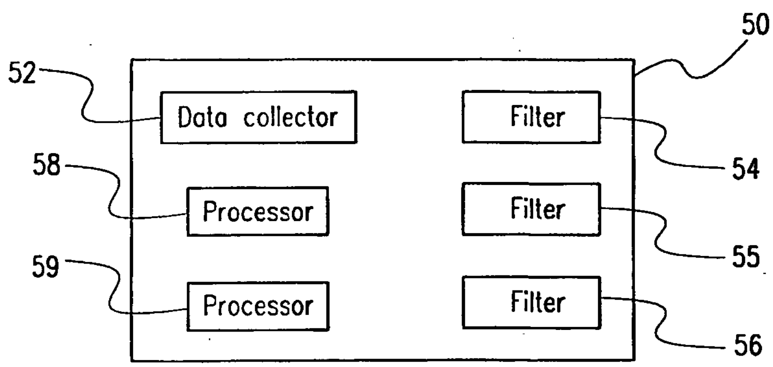

50
52
Data collector
Filter
54
58
Processor
Filter
55
59
Processor
Filter
56

FIG. 5

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 December 2001 (20.12.2001)

PCT

(10) International Publication Number
WO 01/097553 A3

(51) International Patent Classification[7]: H04Q 7/38

(21) International Application Number: PCT/SE01/01376

(22) International Filing Date: 15 June 2001 (15.06.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/593,696 15 June 2000 (15.06.2000) US

(71) Applicant: TELEFONAKTIEBOLAGET L M ERICSSON (publ) [SE/SE]; S-126 25 Stockholm (SE).

(72) Inventors: SAMMOUR, Mohammed; Apt.#1011, 1100 Dr. Penfield, Montreal, Quebec H3A 1A8 (CA). GREYLING, Carl; Avenida Virreyes no. 1590, Lomas de Chapultepec, Mexico, D.F. 11000 (MX).

(74) Agent: MAGNUSSON, Monica; Ericsson Radio Systems AB, Patent Unit Radio Access, S-164 80 Stockholm (SE).

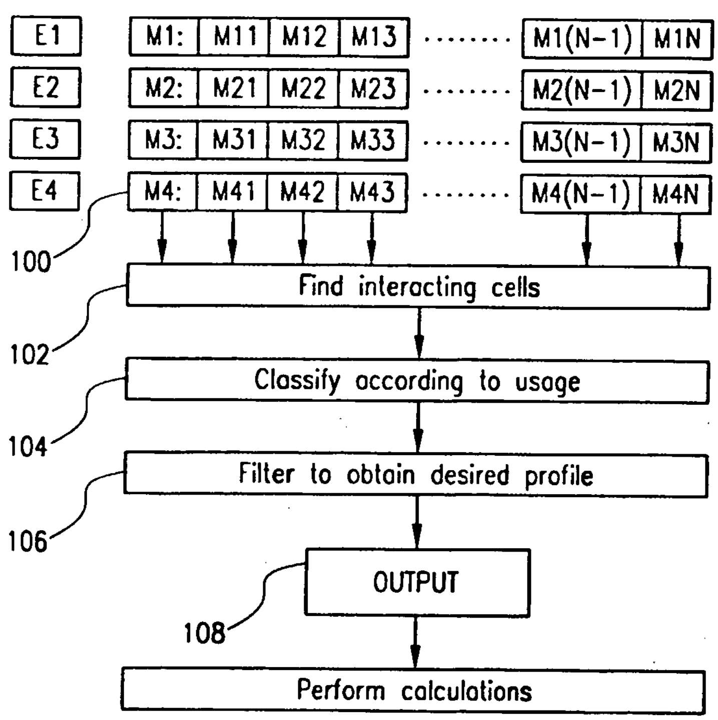
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *with international search report*

*[Continued on next page]*

(54) Title: METHOD AND APPARATUS FOR OBTAINING MEASUREMENT DATA FOR PERFORMANCE ANALYSIS IN A RADIO NETWORK




(57) Abstract: A method and apparatus for obtaining relevant measurement data for analysis of radio network (10) performance. Measurement data (M1-M4) from different network entities (E1-E4) is collected and saved regularly (100). As each saved batch of data is shorter than the total time, temporal accuracy is improved as the time window for when an event could have occurred is shortened. Data processing starts by finding (102) all entities (E2-E4) (usually cells (C1-C4) that potentially interface with the entity (E1) being analysed. The entities (E1-E4) are then classified (104) according to link usage. The measurement data (M1-M4) is filtered (106) to obtain only those records that correspond to a certain network (10)traffic scenario. The output data (108) is suitable for statistical calculations are performed (108) to obtain the results of the analysis.

WO 01/097553 A3

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

**(88) Date of publication of the international search report:** 15 August 2002

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# INTERNATIONAL SEARCH REPORT

International Application No
PCT/SE 01/01376

**A. CLASSIFICATION OF SUBJECT MATTER**
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q H04B H04M H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | US 5 987 055 A (DUQUE-ANTON J M ET AL)<br>16 November 1999 (1999-11-16)<br>column 1, line 55 -column 2, line 23<br>~~column 4, line 40 - line 62~~<br>~~column 6, line 59 -column 7, line 12~~ | 1-13 |
| A | US 5 752 164 A (JONES J BARCLAY)<br>12 May 1998 (1998-05-12)<br>abstract<br>column 3, line 3 - line 12<br>column 9, line 40 - line 44 | 1-13 |
| A | US 5 293 640 A (GUNMAR K ET AL)<br>8 March 1994 (1994-03-08)<br>column 1, line 68 -column 2, line 20<br>column 2, line 63 - line 65<br>column 3, line 1 - line 3<br>column 7, line 32 - line 44 | 1-13 |

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 10 January 2002 | 05. 06. 2002 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016 | Catharina Karlsson |

Form PCT/ISA/210 (second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

International Application No
PCT/SE 01/01376

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 5 926 762 A (ARPEE J E ET AL) 20 July 1999 (1999-07-20) abstract; figure 5 | 1-13 |
| X | WO 98 09231 A (NOKIA TELECOMMUNICATIONS OY ) 5 March 1998 (1998-03-05) page 10, line 25 -page 11, line 7 | 14-22 |
| X | EP 0 994 602 A (3COM CORP) 19 April 2000 (2000-04-19) page 6, line 44 - line 55 abstract; figure 5 | 14-22 |

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

International application No.
PCT/SE 01/01376

# INTERNATIONAL SEARCH REPORT

**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-13

   Relate to a method and an apparatus for obtaining relevant measurement data for a analysis of radio network performance.

2. Claims: 14-22

   Relate to a method for increasing the temporal accuracy of measurement data.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/SE 01/01376

| Patent document cited in search report | | Publication date | Patent family member(s) | | | Publication date |
|---|---|---|---|---|---|---|
| US 5987055 | A | 16-11-1999 | CN | 1128093 | A | 31-07-1996 |
| | | | EP | 0704139 | A1 | 03-04-1996 |
| | | | WO | 9526598 | A2 | 05-10-1995 |
| | | | JP | 8510630 | T | 05-11-1996 |
| US 5752164 | A | 12-05-1998 | US | 5410737 | A | 25-04-1995 |
| | | | CA | 2193741 | A1 | 31-10-1996 |
| | | | WO | 9634501 | A1 | 31-10-1996 |
| | | | CA | 2111688 | A1 | 11-11-1993 |
| | | | WO | 9322845 | A1 | 11-11-1993 |
| US 5293640 | A | 08-03-1994 | SE | 465246 | B | 12-08-1991 |
| | | | SE | 465145 | B | 29-07-1991 |
| | | | SE | 465247 | B | 12-08-1991 |
| | | | AT | 123607 | T | 15-06-1995 |
| | | | AU | 627858 | B2 | 03-09-1992 |
| | | | AU | 5273590 | A | 26-09-1990 |
| | | | CA | 2046274 | A1 | 04-09-1990 |
| | | | DE | 69019961 | D1 | 13-07-1995 |
| | | | DE | 69019961 | T2 | 19-10-1995 |
| | | | EP | 0461192 | A1 | 18-12-1991 |
| | | | ES | 2072428 | T3 | 16-07-1995 |
| | | | JP | 2976211 | B2 | 10-11-1999 |
| | | | JP | 4504038 | T | 16-07-1992 |
| | | | SE | 8900743 | A | 04-09-1990 |
| | | | WO | 9010342 | A1 | 07-09-1990 |
| | | | SE | 8900744 | A | 04-09-1990 |
| | | | SE | 8900745 | A | 04-09-1990 |
| US 5926762 | A | 20-07-1999 | NONE | | | |
| WO 9809231 | A | 05-03-1998 | FI | 963366 | A | 01-03-1998 |
| | | | AU | 728567 | B2 | 11-01-2001 |
| | | | AU | 4017197 | A | 19-03-1998 |
| | | | BR | 9711263 | A | 17-08-1999 |
| | | | CN | 1231745 | A | 13-10-1999 |
| | | | EP | 0922261 | A2 | 16-06-1999 |
| | | | WO | 9809231 | A2 | 05-03-1998 |
| | | | JP | 2000517118 | T | 19-12-2000 |
| | | | US | 6292793 | B1 | 18-09-2001 |
| EP 0994602 | A | 19-04-2000 | US | 6269401 | B1 | 31-07-2001 |
| | | | EP | 0994602 | A2 | 19-04-2000 |